Iowa's Peatlands

by Carol A. Thompson

Groundwater seeping from this Cerro Gordo County hillside has created a permanently saturated deposit of peat that may have been accumulating for several thousand years. Determining the source and quality of recharge waters is an important aspect of protecting these fen sites.
Photo by Carol Thompson.

Mention wetlands to an Iowan and they think of low watery areas with abundant cattails, marsh grasses, and waterfowl. Mention peatlands and the response is likely quite different. Few Iowans are aware that the state has deposits of peat. Peatlands, or mires as they are sometimes called, are more characteristic of northern boreal and subarctic regions, but they actually occur in many climates, even in tropical areas. In the United States, deposits of peat are known to occur in all 50 states.

Peat by definition is a deposit of incompletely decomposed plant remains. Water plays an important role in peat development and evolution, as perennial waterlogging of soil slows the rate of plant decomposition and can lead to the accumulation of peat. The absorbency of peat itself can then affect water movement and perpetuate the conditions for continued peat accumulation. Through examination of plant remains, considerable information can be gleaned about past plant and animal distribution, climatic change, and ancient environments.

Most of the world's peatlands are classified as bogs. Bog is from the Celtic word "bocc," meaning "soft," which is a rather apt description of these waterlogged terrains. A bog is an acidic peatland which depends entirely on rainfall, thus leading to nutrient-poor conditions. Because there is less decomposition in these environments, very fibrous peats are produced. The term "fen," from the Anglo-Saxon meaning "mud," is used to describe another type of peatland which depends on a groundwater source in addition to rainfall, and has a rich nutrient status. Iowa's peatlands are fens. In these more chemically neutral environments, greater plant decomposition occurs leading to a less fibrous, more mineralized material known as muck or peaty muck.

Much of the peat mined in the United States today is used as a soil conditioner and for potting soil. In 1988, 23 states produced 900,000 tons of peat, worth about $20 million; Florida and Michigan are the leading producers. Approximately 14,000 tons of peat were produced from Iowa peatlands in 1988.

The Preserves and Ecological Services Bureau of the Iowa Department of Natural Resources conducted a statewide survey of fens, locating over 100 sites in 23 counties. Iowa's fens are found on upland hillslopes and drainageways, on stream terraces, and within abandoned meanders of rivers. Botanically they are dominated by sedges, grasses, and reeds.

Geologically Iowa's fens are of fairly recent origin, generally less than 6,000 years old. Peats in Northern Europe and Minnesota have radiocarbon dates as old as 10,000 years, but dates from the base of some Midwestern peat deposits only range from 5,500 to 1,200 years old.

An unusual upwelling of mineralized groundwater at Silver Lake Fen State Preserve in Dickinson County collects in elongated pools forming a fragile wetland habitat for rare plants, such as the delicate bloom of grass of Parnassis shown here.
Photo by Jean Prior.

Iowa's fens are home to more than 200 species of plants, including 24 rare species. Twelve of these rare plants are restricted to fen habitats. As such, fens provide important sites for preserving Iowa's botanical diversity. Because these sites depend on groundwater flow, fens may be threatened by deteriorating groundwater quality or by changes in groundwater flow paths. Since Iowa is dominantly an agricultural state, most fens are surrounded by row crops, primarily corn and soybeans which receive heavy applications of agricultural chemicals. Peats do have a great capacity to take up additional nutrients, which is why they have been used to treat sewage sludges. Some studies have shown, however, that excess nutrients, particularly nitrogen, can lead to shifts in species composition and lower species diversity. A shift to more nutrient-tolerant plants could seriously affect survival of the rarer species.

The Iowa Geological Survey is evaluating the hydrology and water chemistry of 20 Iowa fens across the northern part of the state. Monitoring wells have been installed just upslope of each fen. The samples collected during drilling were examined to determine the character of the surrounding geologic materials and, in particular, the characteristics

of the deposit recharging each fen. In 1989, water samples were collected from the wells to evaluate incoming groundwater quality, and from the fens to evaluate chemical interactions within the peat deposit.

The fens can be grouped into four basic geologic settings. The majority of sites are those whose groundwater source is a sand and gravel deposit buried within more clayey glacial materials (inter-till). Past erosion along a drainageway has removed other geologic deposits leaving the sand and gravel unit near the surface, resulting in a seep over which the peat has formed. Another geologic setting includes fens whose groundwater source is an alluvial or glacial outwash sand and gravel originally deposited at the land surface. A few fens appear to be recharged by underlying limestone aquifers; still others are found in abandoned river meanders which may recharge slowly through surrounding silt, sand and gravel.

Knowledge of these various geologic settings enables an assessment of the vulnerability of Iowa fens to loss or degradation. Fens that have sand and gravel at the surface, such as in an alluvial or terrace setting, are highly vulnerable to contaminants infiltrating from the land surface. The vulnerability of fens whose source is a buried sand and gravel is more dependent on the characteristics of the surrounding geologic materials.

There are noticeable differences between the fens in eastern and western Iowa. Eastern sites respond quickly to changes in precipitation, which is also reflected in their vegetation. During drought conditions, eastern fens are drier; during wetter periods, the fens recover quickly. The western fens also respond to changes in precipitation, but on a delayed basis. Exceptions to this are the western fens in alluvial or terrace settings where precipitation changes are rapidly translated to the fen. The reasons for these variations relate to differences in geologic materials surrounding the fens. The materials upslope of the eastern sites are more permeable and allow rapid flow-through of water. The glacial deposits around the western fens have slower infiltration rates and also allow more water to be stored, thus damping precipitation response.

There are also differences in water chemistry between eastern and western fens. Western sites have higher dissolved-mineral concentrations than eastern sites in the groundwater sampled from both the upslope wells and within the fens. This trend is particularly noticeable for calcium, magnesium, and sulfate concentrations. These differences may be the result of the climatic gradient across the state, which becomes drier to the northwest. Alternately the trend may be related to differences in the geologic materials. Slower recharge rates allow more time for minerals to be leached from the surrounding glacial deposits. Also, western Iowa glacial materials often contain gypsum, a calcium-sulfate mineral. Nitrate concentrations at the fens are high, with 8 of 20 sites having concentrations over the drinking water standard (45 mg/L as nitrate), and 14 of 20 sites having concentrations elevated over normal background concentrations.

Nitrate concentrations decrease to the west, a reverse trend from that of most chemical ions. The higher recharge rates for the eastern Iowa sites and the alluvial and terrace

settings in western Iowa allow nitrate from the surface to move more readily into the aquifer and then into the fen.

Pesticides were found at 11 sites in 7 wells and 10 fens. Atrazine, cyanazine, metolachlor, alachlor, metribuzin, and trifluralin were all detected, most at concentrations just above the detection limit. Of note was the fact that different pesticides were found in the wells in contrast to the fens. There are several possible explanations. The movement of pesticides in fens may be retarded with the result that the pesticides may represent last year's or even older field applications. Alternately, pesticides in the fens may be entering by different pathways, such as surface runoff (although this appears minimal at many sites) or through rainfall.

Direct physical threats also exist to Iowa's fens. Cattle trampling can cause serious and sometimes irreversible damage. Draining of fens is another irreversible alteration. Even tapping fens for watering livestock can alter their flow characteristics and cause detrimental changes.

Our studies of Iowa fens are continuing. Further stratigraphic studies will include topographic mapping, peat-thickness mapping, and collecting samples for radiocarbon dates. Detailed water-quality studies will be done on selected sites. This will help define the groundwater flow paths at these sites, and also allow an assessment of variations in water quality over time.

Peatlands world-wide are being threatened. Although many virgin peatlands still exist, only a small percent are protected in most countries. Only seven of Iowa's fens are protected in parks, preserves, or wildlife areas. Hydrogeologic data will provide us with important information about the sources of the groundwater system, potential threats to the system, and possible remedial actions to restore damaged fens. This, in turn, will enable development of a more complete protection strategy, such as the use of buffer lands and easements for protection of present and potential fen preserves.

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